

Monitoring Dall's sheep in Alaska's Arctic Parklands

By K. Rattenbury, J. Schmidt and L. Phillips

A Super Cub airplane ventures into the Brooks Range, its crew searches carefully for one of Alaska's hardest inhabitants. The vast, wild character of these Arctic parklands impresses the pilot and observer as they scan the rugged landscape. Flying along a mountain contour, they spot a group of white dots high on a rocky slope, and, moving closer, are able to identify and count a band of Dall's sheep.

Dall's sheep are one of 28 vital signs monitored by the Arctic Network Inventory and Monitoring Program (ARCN I&M) because of their importance to the public and in assessing the overall health of the regional ecosystem. Dall's sheep are a valued subsistence species for local residents, and sport hunting is permitted in the preserves. They live at the northern limit of their range in these arctic mountains and may serve as a sensitive indicator of environmental change. As a relatively sedentary, alpine species, Dall's sheep are one of the most visible large mammals for wildlife viewing.

Dall's sheep habitat in the central and western Brooks Range encompasses about 15,800 square miles (41,000 km²), an area roughly twice the size of New Jersey. Most of this is within Gates of the Arctic National Park and Preserve (Gates of the Arctic), Noatak National Preserve (Noatak) and Kobuk Valley National Park (Kobuk Valley) (Figure 1). Monitoring the abundance and distribution of Dall's sheep in these parklands is a priority for the Arctic Network, but the immense size and remote nature of this region presents a daunting challenge for designing a statistically valid sampling strategy. Practical considerations, such as accessibility and cost, limit design alternatives that can realistically be implemented.

The central and western Brooks Range likely contained

13-15% of the world's population of Dall's sheep in the early 1980s (Valdez and Krausman 1999). An aerial census conducted from 1982 to 1984 estimated a minimum of 10,939 Dall's sheep in Gates of the Arctic (Singer 1984) and 1,687 sheep in Noatak (Singer et al. 1983). A substantial decline was observed in the late 1980s and early 1990s concurrent with several years of severe winter weather (Shults 2004, Whitten 1997). Although more recent studies indicate a slight recovery and stabilization in some areas (e.g., Shults 2004, Lawler 2004), these numbers remain lower than were observed in the early 1980s. Most of the region has been infrequently or incompletely surveyed since 1984, and previous surveys vary in methodology and success. These inconsistencies prevent park managers from detecting trends in Dall's sheep abundance in parks, much less on a regional scale.

In 2005 and 2006, the Arctic Network attempted to systematically re-census the central and western Brooks Range by fixed-wing aircraft. Far less area was surveyed than planned, and, in 2007, the survey methods were modified for stratified random sampling. Survey subunits were stratified by sheep density based on the most recent data, and randomly selected for survey order. Data for all three years were analyzed using methods described by Gasaway et al. (1986). Regional abundance estimates (\pm 95% confidence interval; unadjusted for sightability) were 10,611 \pm 2,533 sheep in 2005-2006 and 7,258 \pm 2,710 sheep in 2007 (Rattenbury and Lawler, in prep.). The large variances, lack of current region-wide density data, movement of sheep between subunits, and long ferry times for aircraft make stratified random sampling difficult in this large and remote region. Surveys of large units that require multiple survey days, as were done in 2005 and 2006, are problematic because weather, funding and other logistical constraints may prevent complete coverage. A new strategy

was needed to improve the precision of the estimate and to decrease cost and simplify sampling logistics.

2009 Survey

In 2009, the Arctic Network collaborated with staff from the Central Alaska Network and Denali National Park and Preserve to test distance sampling methods in Gates of the Arctic. With this technique, observers search for sheep while traveling along a designated series of lines. Abundance estimates are based on the distance of animal sightings from the survey line and the assumption that detection is 100% for animals located on the line and diminishes with increasing distance from the line. In mountainous terrain, the transect lines follow elevation contours. Contour transects have been used successfully to estimate bear abundance in southwestern Alaska (Quang and Becker 1999), and these methods are expected to improve estimates of abundance and density of Dall's sheep without an increase in survey cost or time.

A custom ArcGIS 9.2 (ESRI, Redlands, California) application (NPS Animal Transect Tool, GeoNorth, LLC, Anchorage, Alaska) was used to generate 316, 12.4 mi (20 km) long transects on a 6.2-mi (10-km) grid across Gates of the Arctic (Figure 2). The transects were surveyed June 23-30 by four pilot-observer teams based in Anaktuvuk Pass, Bettles, Coldfoot and Dahl Creek. Follow-up surveys to finish 28 transects that had >30% snow cover in June were conducted July 22-25 by one team. The pilots followed the contour transects at approximately 300 ft (92 m) above ground level, and the pilot and observer worked together to search uphill from the line. When sheep were detected, the observer recorded the GPS location and group size on a laptop computer running an ArcPad (ESRI, Redlands, California) application that automatically recorded the flight path.

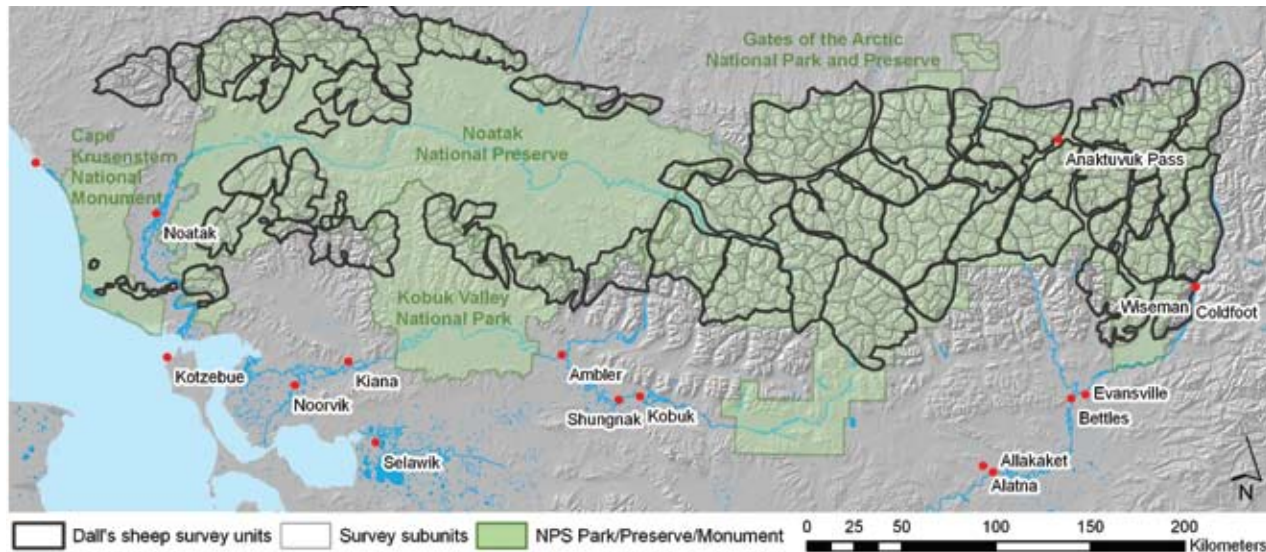


Figure 1. Over 15,800 mi² (41,000 km²) of sheep habitat have been delineated in the central and western Brooks Range of Alaska. Historically, sheep surveys were conducted using survey unit boundaries designated by Singer (1984) and Singer et al. (1983).

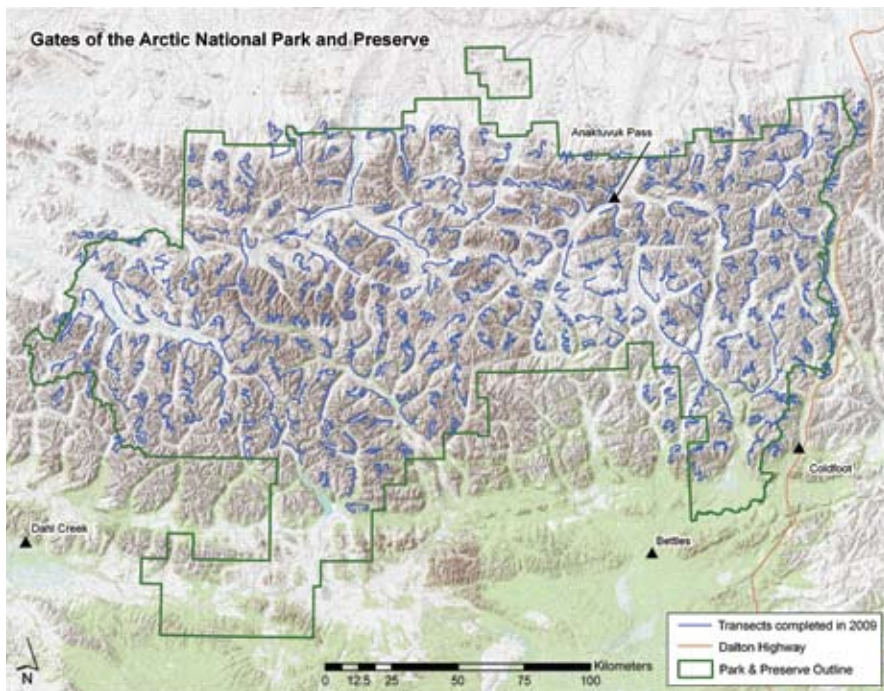


Figure 2. In 2009, the Arctic Network surveyed Dall's sheep using a new technique that required observers to search for animals along contour transect lines. Teams flew 308 randomly placed transects and recorded the locations of sheep groups using a laptop computer.

Between the June and July surveys, 308 of the 316 transects were flown. Pilot-observer teams recorded 166 groups, totaling 727 individual Dall's sheep on 73 transects. The majority of the observed sheep were in northeastern and southwestern Gates of the Arctic. Program Distance 5.0 (Thomas et al. 2006) will be used to calculate an abundance estimate for Gates of the Arctic.

Several transects fell below tree-line or were not in sheep habitat. Contour transects must be randomly generated in all possible Dall's sheep habitat, but this area was overestimated for the 2009 survey. Efforts in 2010 will involve spatial modeling of vegetation cover, topography, and elevation to eliminate forested areas coupled with an investigation of terrain complexity to avoid missing features such as low elevation river bluffs where Dall's sheep may be found. Additionally, future surveys will involve transects at different elevations on the same mountain to maximize coverage of potential habitat.

Implications for Future Monitoring

The Arctic Network will continue to work with the Central Alaska Network and park biologists to test distance sampling for estimating Dall's sheep abundance. Surveys with revised methods for generating contour transects are planned for 2010 in Gates of the Arctic, Wrangell-St. Elias, and Lake Clark National Parks and Preserves. If these surveys produce satisfactory results, the methods will be applied in Noatak, Kobuk Valley, and Denali National Park and Preserve. One of the main advantages of distance sampling is the ability to generate abundance estimates for entire park units including estimates of precision and accuracy for less cost than a census. Distance sampling also addresses the issue that an unknown proportion of sheep are not seen during aerial surveys by estimating the number of sheep not detected. Moreover, data from multiple survey years can be used to produce density distribution maps. A goal of the Arctic and Central Alaska Network collaboration is to provide survey protocols that can detect park-wide changes in Dall's sheep abundance and distribution.

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Figure 3 and Figure 4. Observers photographed groups of Dall's sheep to aid in count and classification of large groups and 'cryptic' sheep.

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